Be-FAST – Between Farm Animal Spatial Transmission:

An epidemiological model for studying the spread and the economic impact of animal diseases.

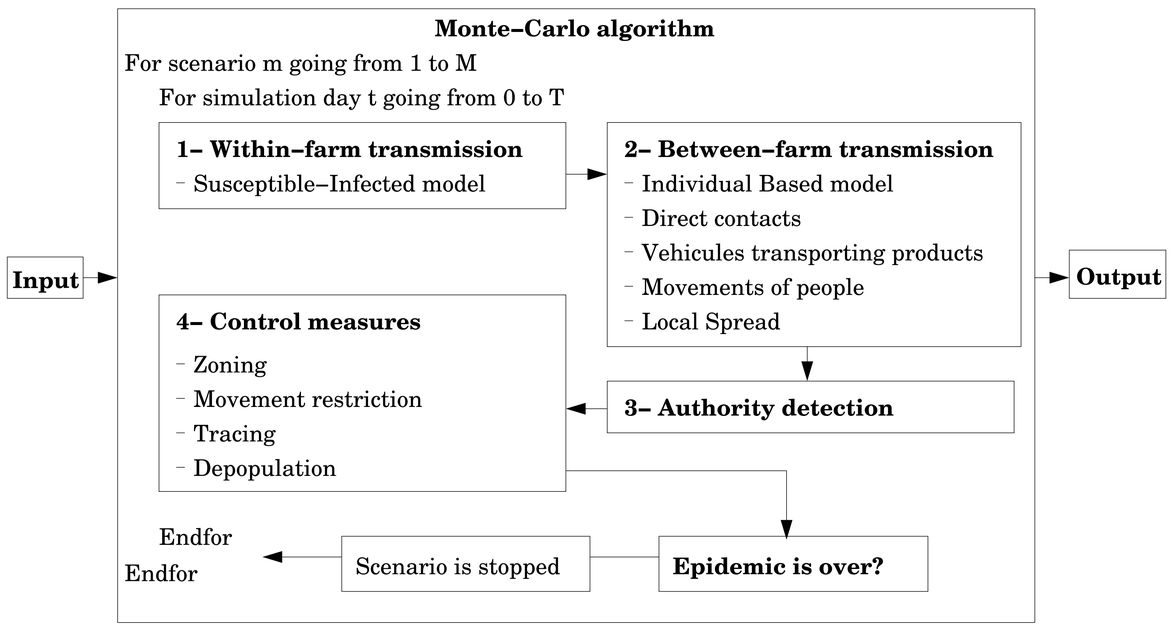
Benjamin Ivorra * , Eduardo Fernández Carrión, Beatriz Martínez-López, José M. Sánchez-Vizcaíno, Ángel M. Ramos

Work founded by: Spanish National Project MTM2011-22658 – European Project CSFV_go-DIVA (KBBE-227003) – Proyecto regional integrado para el control progresivo de la fiebre aftosa (GCP/RLA/178/SPA Y GTSF/RLA/172/ITA) – * E-mail: ivorra@mat.ucm.es

1. Main characteristics of Be-FAST

- Simulate both the **between farm** and **within farm** spread of the considered disease in a given region.
- Evaluation of the **economical impact** of a disease outbreak by considering direct and indirect costs.
- Adaptable to **different animal diseases**.
- Possibility to use **real and complex database** for farms and transports for simulating realistic commercial contacts between farms.
- Possibility to use **dynamic coefficients** based, for instance, on the number of infected animals.
- **Large choice of output**, such as:risk maps, R0 values, statistics on the magnitude and duration of epidemic, etc.

2. Structure of the model

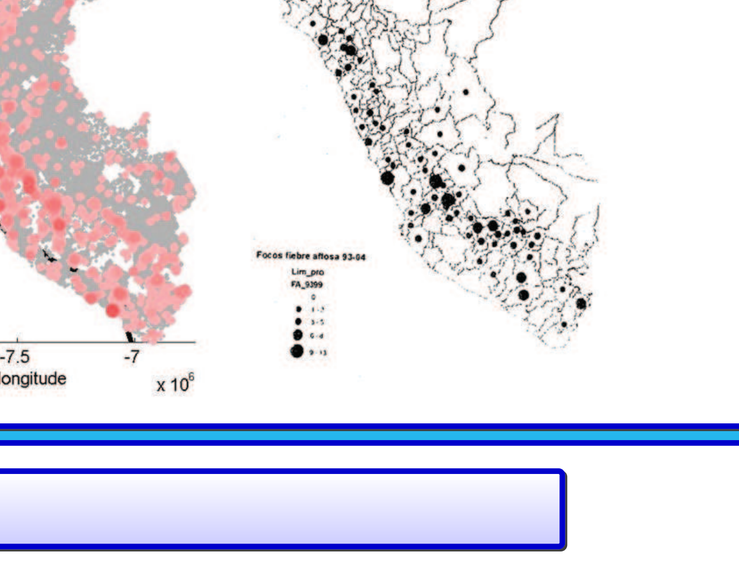


3. Model validation and sensitivity analysis: Classical Swine Fever in the Spanish province of Segovia

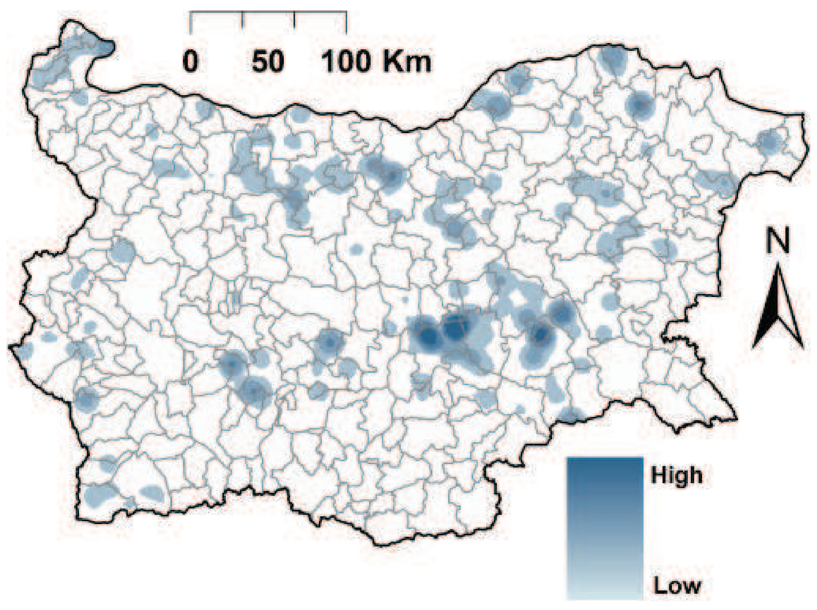
Some results obtained when considering models **Be-FAST** and **InterSpread +** and **Real** outbreaks data occuring in 1997-98:

- **TABLE: Computational time** in hours; % of infection due to each CSFV **Route**: local spread (*LS*), Integrator vehicles (*INT*), Sanitary Defense Association persons (*SDA*) and transport of animals (*TA*); % of detection due to each control **Measure**: observation of clinical signs (*CS*), zoning (*ZO*) and tracing (*TR*)
- **FIGURE:** Risk map of CSFV introduction given by **a)** Be-FAST and **b)** InterSpread +. ★ denotes the location of real infected farms.

Model	Comp. Time (h)	Route				Measure		
		LS	*INT*	*SDA*	*TA*	*CS*	*ZO*	*TR*
Be-FAST	4	54	26	14	6	47	30	23
Inter S+	3	51	13	10	26	38	50	12
REAL	-	52	24	20	4	55	27	18



4. Application: Classical Swine Fever in Bulgaria



5. Application: Foot and Mouth Disease in Peru

6. Some References

[1] B. Martínez-López, B. Ivorra, E. Fernández Carrión, T. Alexandrov, A.M. Ramos and J.M. Sánchez-Vizcaíno. *Evaluation of the risk of classical swine fever (CSF) spread from backyard pigs to other domestic pigs by using the spatial stochastic disease spread model Be-FAST: The example of Bulgaria.* **Veterinary Microbiology**. Science Direct Online. 2013

[2] B. Ivorra, B. Martínez-López, J.M. Sánchez-Vizcaíno and A,M. Ramos. *Mathematical formulation and validation of the Be-FAST model for Classical Swine Fever Virus spread between and within farms.* **Annals of Operations Research**. Online First. 2013

[3] B. Martínez-López, B. Ivorra, D. Ngom, A.M. Ramos and J.M. Sánchez-Vizcaíno. *A novel spatial and stochastic model to evaluate the within and between farm transmission of classical swine fever virus: II Validation of the model.* **Veterinary Microbiology, 155: 21-32**. Elsevier. 2012.

[4] B. Martínez-López, B. Ivorra, A.M. Ramos and J. M. Sánchez-Vizcaíno. *A novel spatial and stochastic model to evaluate the within and between farm transmission of classical swine fever virus: I. General concepts and description of the model.* **Veterinary Microbiology, 147: 300-309**. Elsevier. 2011.